inducing factor in affecting cells to produce interferon gamma. To this end, cloned cDNAs encoding antibodies or fragments thereof are used to genetically modify receptive cells, to thereby render the cells antibody producing cells.

Cloning of cDNAs encoding antibodies or fragments thereof may be accomplished by several approaches known in the art. In the preferred approach, mRNA from clonal hybridoma cell lines which produce antibodies is employed as starting material. The cells are harvested and mRNA is extracted by standard methods known in the art. The cDNA is prepared by reverse transcription of the mRNA by standard methods known in the art. The cDNA for each chain of the immunoglobulin is cloned separately, and may be amplified by polymerase chain reaction using appropriate primers. The cDNA is then ligated into appropriate vectors by standard methods. The cDNA may be cloned into expression vectors and expressed separately in any convenient expression system, so that the properties of the expressed single chains of the antibodies may be determined. Alternatively, the individual chains may be expressed in the same cells which are then screened for the production of recombinant active antibodies. The method of using the invention will be modified in accordance with the system that is selected according to the current principles that are known in the art of recombinant protein production. According to the present invention the genetic information for the production of the antibody of interest is introduced into the cells by an appropriate vector as is known in the art or by any other acceptable means. The present invention provides information that will enable the skilled artisan to prepare constructs of genetic material comprising an open reading frame that encodes at least one chain of a novel antibody capable of binding IGIF. It will be appreciated that in certain embodiments it will suffice to produce an active fragment of the catalytic activity, for instance a Fab fragment of the intact antibody or even an Fv fragment thereof. In addition to the nucleic acid encoding the protein or polypeptide of choice, the constructs of the invention may comprise the following elements: a selectable marker, an origin of replication, a transcriptional promoter, a translation start site, a signal sequence for secretion of the product.

U.S. Pat. application No. 09/123,485, filed July 28, 1998, which is incorporated by reference as if fully set forth herein, teaches the effectiveness of DNA vaccines in inducing protective immunity against multiple sclerosis. In that application, DNA sequences encoding for a

variety of chemokines and for the cytokine tumor necrosis factor alpha, were shown to elicit protective immunity against both induced and transferred EAE, while the prior art teaches protective immunity against both induced and transferred EAE via passive vaccination (administration of antibodies).

Similarly, DNA vaccination in various forms, some of which are further detailed hereinunder, can be used to confer protective immunity against multiple sclerosis.

Thus, according to another aspect of the present invention there is provided a method for treating an animal for inducing protective immunity against multiple sclerosis. The method is effected by administering to the animal a therapeutic composition including a recombinant construct including an isolated nucleic acid sequence encoding a polypeptide being capable of eliciting antibodies capable of *in vivo* neutralizing an interferon gamma inducing factor in affecting cells to produce interferon gamma.

According to yet another aspect of the present invention there is provided a method for treating an animal for inducing protective immunity against multiple sclerosis. The method is effected by implementing the following method steps, in which, in a first step, cells are removed from the animal. In a second step, the cells are genetically modified *in vitro* with a recombinant construct including an isolated nucleic acid sequence encoding an interferon gamma inducing factor or an immunogenic portion thereof. Finally, the genetically modified cells are reintroduced to the animal.

As used herein in the specification and in the claims section below, the term "genetically modified" refers to a process of inserting nucleic acids into cells. The insertion may, for example, be effected by transformation, viral infection, injection, transfection, gene bombardment, electroporation or any other means effective in introducing nucleic acids into cells. Following the modification the nucleic acid is either integrated in all or part, to the cell's genome (DNA), or remains external to the cell's genome, thereby providing stably modified or transiently modified cells. The cells according to this method of the invention may be of any kind. Especially suitable cells are those readily removable, genetically modifiable, and reintroduceable cells, such as, but not limited to, cells of the various blood lineages, derived either from whole blood or from bone marrow, fibroblast cells, etc. The genetically modified cells are preferably reintroduced to the animal parenterally.

According to still another aspect of the present invention there is provided a pharmaceutical composition for inducing protective immunity against multiple sclerosis. The composition comprises a pharmaceutically acceptable carrier and a recombinant construct including an isolated nucleic acid sequence encoding a polypeptide being capable of eliciting antibodies capable of *in vivo* neutralizing an interferon gamma inducing factor in affecting cells to produce interferon gamma.

According to a preferred embodiment of the present invention, the nucleic acid sequence is operatively linked to one or more transcription control sequences, such as, but not limited to, RSV control sequences, CMV control sequences, retroviral LTR sequences, SV-40 control sequences and/or β-actin control sequences. Preferably, the recombinant construct is an eukaryotic expression vector, such as, but not limited to, pcDNA3, pcDNA3.1(+/-), pZeoSV2(+/-), pSecTag2, pDisplay, pEF/myc/cyto, pCMV/myc/cyto, pCR3.1, pCI, pBK-RSV, pBK-CMV, pTRES, and their derivatives.

According to a preferred embodiment of the present invention, the therapeutic composition is administered to the animal parenterally. According to another preferred embodiment of the present invention, the animal is a human being.

According to still further features in the described preferred embodiments the pharmaceutically acceptable carrier is selected from the group consisting of an aqueous physiologically balanced solution, an artificial lipid-containing substrate, a natural lipid-containing substrate, an oil, an ester, a glycol, a virus and metal particles. Preferably, the pharmaceutically acceptable carrier comprises a delivery vehicle that delivers the nucleic acid sequences to the animal. The delivery vehicle can be effected by liposomes, micelles or cells.

Additional objects, advantages, and novel features of the present invention will become apparent to one ordinarily skilled in the art upon examination of the following examples, which are not intended to be limiting. Additionally, each of the various embodiments and aspects of the present invention as delineated hereinabove and as claimed in the claims section below finds experimental support in the following examples.